REMARKS

Claims 11-14 have been cancelled so that claims 6-10, 16-24 and 26-52 are now in the application. Claims 31-34 have been withdrawn from consideration. Claims 7-10, 17-20, 27-30 and 35-43 have been allowed.

The Examiner objected to the specification on the basis that the recitation reciting "hot electrodes" in claims 46, 49 and 52 should be changed to --hot electrons--. These claims have been so amended.

Claim 6 was rejected under 35 USC 103(a) as being unpatentable over Sato in view of Gill and Mori. Claim 6 is distinguished over these patents by reciting:

> "one of the first and second AP pinned layers having a cobalt iron (CoFe) film with a positive magnetostriction;
>
> the CoFe film having a magnetostrictive anisotropy field that is oriented perpendicular to a head surface of the spin valve transistor for self pinning the AP pinned layer structure; and
>
> the first and second AP pinned layers having the same magnetic thickness.

This structure is exemplified in Fig. 10 wherein one of the AP pinned layers 216 of the first and second AP pinned layers has a cobalt iron film 242 with a positive magnetostriction with the cobalt iron film 242 having a magnetostrictive anisotropy field that is oriented perpendicular to a head surface of the spin valve transistor for self-pinning the AP pinned layer structure 212 and the first and second AP pinned layers 214 and 216 have the same magnetic thickness. In support of his rejection the Examiner states:

> "Sato discloses in figs. 1, 3, 9 and 15 a spin valve transistor comprising an emitter E/15/17; a collector C; a base B between the emitter and the collector; a spin valve including a ferromagnetic free layer structure MF/11; a self-pinned antiparallel (AP) pinned layer structure MP/7 without any pinning structure pinning the self pinned AP pinned layer structure; and a nonmagnetic spacer layer NM/9 between the free layer structure and the AP pinned layer structure; . . ."

The only teaching in Sato that refers to the structure of the pinned layer is discussed in paragraph 0071 which states:

> "[0071] The magnetization pinned layer 7 and the magnetization free layer 11 may be in any form of a single layer of one magnetic metal, a laminate structure of different magnetic metal layers, or a laminate structure of a magnetic metal layer(s) and a dielectric layer(s). The magnetic metal material for the layers includes various magnetic metals such as iron (Fe), cobalt (Co) and nickel (Ni), and various magnetic alloys containing any one of iron, cobalt and nickel."

While this teaching may suggest an AP pinned layer there is no suggestion in the teaching by Sato that the AP pinned layer structure is self-pinned. In further support of his rejection the Examiner states:

> "Gill discloses in fig. 12 a self pinned AP pinned layer structure without any pinning structure pinning the self-pinned AP pinned layer structure comprising a ferromagnetic first antiparallel (AP) pinned layer 210; a ferromagnetic second antiprallel (AP) pinned layer 212; a nonmagnetic antiparallel coupling (APC) layer 208 located between the first and second AP pinned layers; one of the first and second AP pinned layers having a cobalt iron (CoFe) film with a positive magnetostriction; and the CoFe film having a magnetostrictive anisotropy field that is oriented perpendicular to a head surface of the spin valve for self pinning the AP pinned layer structure."

The Applicant respectfully disagrees with the Examiner that Gill teaches a self-pinned AP pinned layer structure. In contrast, the AP pinned layer structure 204, as shown in Fig. 12 of Gill, is pinned by an antiferromagnetic layer 214. This is discussed in Gill in column 7, lines 40-51, which state:

> " . . . . . The first AP pinned layer 210 may be exchange coupled to an antiferromagnetic layer 214 via an interlayer 216. With this arrangement the magnetic moment of the first AP pinned layer 210 is pinned perpendicular to the ABS, such as away from the ABS as shown at 218, and the second AP pinned layer 212 is pinned antiparallel thereto, as shown at 220. The first and second AP pinned layers 210 and 212 are preferably cobalt iron (CoFe). It has been found that an interlayer 216 of nickel iron (NiFe) improves the texture of the cobalt iron (CoFe) material of the first AP pinned layer 210 when it is constructed on a nickel oxide (NiO) AFM layer 214."

While one of the cobalt iron AP pinned layers 210 and 212 may have a positive magnetostriction that is oriented perpendicular to the head surface, there is no teaching that the cobalt iron AP pinned layer has a magnetostrictive anisotropy field that is oriented perpendicular to a head surface of the spin valve transistor for self-pinning the AP pinned layer structure as recited in claim 6 hereinabove. Claim 6 hereinabove requires that one of the first and second AP pinned layers have a cobalt iron film which implements the self-pinning of the AP pinned layer structure which is not taught by any of the references. In still further support of his rejection the Examiner states:

> "Mori discloses in figs. 3 and 7 a self pinned layer structure without any pinning structure pinning the self pinned AP pinned layer structure comprising a ferromagnetic first antiparallel (AP) pinned layer 303/503, a ferromagnetic second antiprallel (AP) pinned layer 305/505 having the same magnetic thickness; a nonmagnetic antiparallel coupling (APC) layer 304/504 located between the first and second AP pinned layers."

The Applicant respectfully disagrees with the Examiner that the structure 303/503 in figs. 3 and 7 of Mori is an AP pinned layer structure. In contrast, these structures are free layers. This is first discussed in the summary of the invention in Mori in paragraph 0028 which states:

> "[0028] Therefore, according to the present invention, it is possible to readily obtain the laminated ferrimagnetic thin film which has a magnetic characteristic (rapid magnetization reversion with a small coercive force) *suitable for the free magnetic layer* in the magneto-resistive effect element (without performing precise non-magnetic intermediate layer film thickness control)." (*emphasis added*)

In regard to the fig. 3 embodiment of Mori, Mori states:

> "[0063] It is to be noted that the above-described magnetic laminated ferrimagnetic thin film can be combined with a pinned magnetic layer as will be described later *and used as a free magnetic layer* in a magneto-resistive effect element or a ferromagnetic tunnel element. . . . ." (*emphasis added*)

Fig. 5 of Mori is an example of the implementation of Mori's AP structure in fig. 3 into a ferromagnetic tunnel element wherein the free layer 414 comprises the AP structure taught in figure 3. This is supported by paragraph 0090 of Mori which states:

> "[0090] Description will now be given as to an operation of the magnetoresistive effect element having the above-described structure. The first main ferromagnetic layer 406 and the first interface ferromagnetic layer 407 constitute the first free magnetic layer 412, and the second main ferromagnetic layer 410 and the second interface ferromagnetic layer 408 constitute the second free magnetic layer 413. The first free magnetic layer 412 and the second free magnetic layer 413 are magnetically coupled in such a manner that directions of their magnetic moments become anti-parallel to each other by the anti-ferromagnetic exchange bonding effect through the non-magnetic intermediate layer 408, and function as a free magnetic layers. *The first free magnetic layer 412, the non-magnetic intermediate layer 408 and the second free magnetic layer 413 constitute the free magnetic layer 414.* In addition, the pinned magnetic layer 404, the non-magnetic layer 405 and the free magnetic layer 414 constitute a magneto-resistive effect portion 415 which varies the resistance due to a change in an external magnetic field and demonstrates the magneto-resistive effect." (*emphasis added*)

Regarding the pinned layer 404 in fig. 5 of Mori, Mori states in paragraph 0088 as follows:

> " . . . . . Moreover, the pinned magnetic layer 404 can be constituted by a plurality of layers. In particular, a laminated ferri type three-layer structure or a two-layer structure including the ferromagnetic layer/antiferromagnetic layer is more preferable since it can positively fix its magnetization direction."

Further, there is no teaching that one of the first and second AP pinned layers has a cobalt iron film that has a magnetostrictive anisotropy field that is oriented perpendicular to the head surface of the spin valve transistor for self-pinning the AP pinned layer structure. The fig. 7 embodiment of Mori is discussed in the same manner as the fig. 3 embodiment in that the AP pinned structure is employed as a free layer. This is discussed in paragraph 0122 of Mori. Other examples of employing the AP free layer structure in a spin valve or a tunnel valve head is shown in Figs. 6 and 18.

Claim 16 was rejected under 35 USC 103(a) as being unpatentable over Gill in view of Sato and Mori. Claim 16 recites the same limitations as quoted hereinabove from claim 6 and is considered to be patentable over these references for the same reasons as given in support for claim 6.

Claim 26 was rejected under 35 USC 103(a) as being unpatentable over Gill in view of Sato and Mori. Claim 26 recites the same limitations quoted hereinabove from claim 6 and is considered to be patentable over the references for the same reasons as given in support for claim 6.

Claims 44-52 were rejected under 35 USC 103(a) as being unpatentable over Gill in view of Mori, Sato and Ito. Claims 44, 47 and 50 are distinguished over the references by reciting:

"... wherein at least one of the AP pinned layers is $Co_{50}Fe_{50}$."

This is shown in Applicant's Fig. 10 wherein one of the AP pinned layers 216 is $Co_{50}Fe_{50}$, as shown in layer 242. In support of his rejection the Examiner states:

> "Ito discloses (fig. 2 and par. 0048) a spin valve transistor comprising at least one AP layer being Co(50)Fe(50)."

The Applicant respectfully disagrees with the Examiner that Ito discloses an AP layer. As shown in Fig. 2B of Ito there is shown only a single pinned layer 105 which may be $Co_{50}Fe_{50}$. As taught by paragraph 0038 of Ito the pinned layer 105 is pinned by an antiferromagnetic layer 104. Even though the pinned layer 105 can be $Co_{50}Fe_{50}$ it does not implement a self-pinning as set forth in parent claims 6, 16 and 26.

It should be noted that all of the rejected claims recite the first and second AP pinned layers 214 and 216 in Fig. 10 as having the same magnetic thickness. Assuming hypothetically that each of the first and second AP pinned layers is composed of the same material, such as CoFe, with the same proportions there would be no self-pinning of such an AP pinned layer structure since they would both have the same magnetostrictive anisotropy field strength perpendicular to the head surface. One of the AP pinned layers has to be stronger in its magnetostrictive anisotropy field than the other AP pinned layer in order to implement the self-pinning. Assuming again hypothetically that the first and second AP pinned layers have the same magnetic thickness with one of the AP pinned layers being $Co_{50}Fe_{50}$ and the other AP pinned layer being $Co_{90}Fe_{10}$, the first AP pinned layer

will have a stronger magnetostrictive anisotropy field which is oriented perpendicular to the head surface for self-pinning the AP pinned layer structure. In order to protect the Applicant's invention, claims 6, 16 and 26 require that only one of the first and second AP pinned layers have a CoFe film and that this AP pinned layer have a magnetostrictive anisotropy field that is oriented perpendicular to the head surface for self-pinning the AP pinned layer structure. The CoFe film can be something other than $Co_{50}Fe_{50}$, such as $Co_{90}Fe_{10}$, providing it has a sufficient magnetostrictive anisotropy field strength that is oriented perpendicular to the head surface for self-pinning the AP pinned layer structure. The other AP pinned layer 214 can be iron (Fe) as shown in Fig. 10. If the CoFe film of the one AP pinned layer 216 is $Co_{50}Fe_{50}$ 242, as shown in Fig. 10, the other AP pinned layer 214 may be CoFe wherein the cobalt is higher than 50, such as $Co_{90}Fe_{10}$. The main thing is that one of the first and second AP pinned layers have a CoFe film with a magnetostrictive anisotropy field that is oriented perpendicular to the head surface of the spin valve transistor for self-pinning the AP pinned layer structure.

The Examiner is respectfully requested to contact the undersigned should there be any questions regarding this Amendment.

Respectfully submitted,

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